06389
EQUIPMENT
PROPERTY

INSTRUCTION MANUAL

MODEL 650

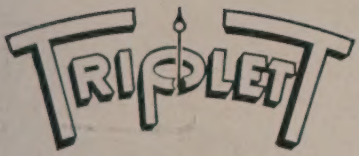
VACUUM TUBE VOLTMETER

MANUAL ONLY - $ .50

68

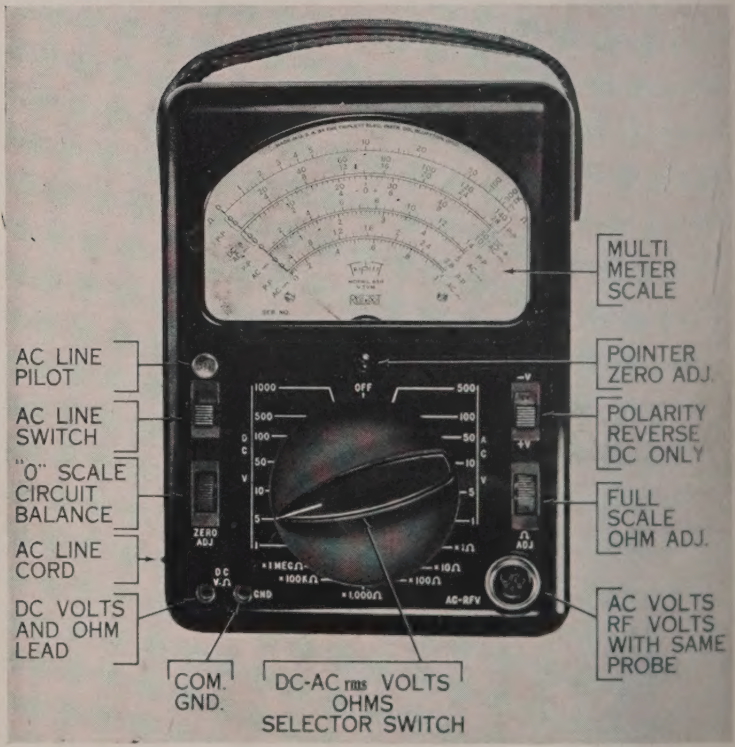
INSTRUCTION MANUAL

NO 86 SHIELDING TROUBLE-
NEED NEW SHIELDING



MODEL 650
VACUUM TUBE VOLTMETER

THE TRIPLETT ELECTRICAL INSTRUMENT CO.
BLUFFTON, OHIO


MULTI METER SCALE
POINTER ZERO ADJ.
POLARITY REVERSE DC ONLY
FULL SCALE OHM ADJ.
AC VOLTS RF VOLTS WITH SAME PROBE
AC LINE PILOT
AC LINE SWITCH
"0" SCALE CIRCUIT BALANCE
AC LINE CORD
DC VOLTS AND OHM LEAD
COM. GND.
DC-AC rms VOLTS OHMS SELECTOR SWITCH
OFF
ZERO ADJ
GND
AC-RFV

Model 650

TECHNICAL DATA

Power

115 Volts AC 50-60 cps power consumption 6½W.

Ranges

DC Volts 0-1-5-10-50-100-500-1000
AC & RF Volts 0-1-5-10-50-100-500
Peak to Peak (P-P) Volts 0-2.8-14-28-140-280-700
Peak to Peak (P-P) value of sine wave to 1400 Volts.
Ohms, six ranges, 0-1000-10,000-100,000-1 Meg.-10 Meg.-100 Meg.
Decibels—Table on page 17 for different impedances.
Galvanometer center mark "+" for discriminator alignment on all DCV ranges —.5 to +.5 volts on 0-1 DCV range.*

Frequency Range AC-RF

15 CPS. to 150 MC.

Input Impedance

DC Volts 11 Megohms — AC-RF Volts 1.4 Megohm 13 mmf at 1 MC.

Accuracy

DC Volts = 3%, AC-RF = 5% at 60 cps, ohms = 3% of linear scale.

Meter

DC Current for full-scale deflection 200 μa. Meter 5½ inch type with 4⅜ inch scale length.
DC-AC rms scale black on white.
1 V. AC and 5 V. AC Scales black on white (Separated scales for greater accuracy).
Ohms scale black on white.
Peak to Peak (P-P) scale red on white.

Tube Complement

1—12AU7, 2—6AL5.

Construction

Insulated case; dimension outside 3¾"×5½"×7½" with removable black leather strap handle. Panel black molded with white markings and one selector switch for all ranges.

Weight

5 pounds. (Complete with battery and accessories)

Accessories supplied with Model 650

1 AC Power Cord
1 DC Volt and ohms lead (shielded)
1 AC Volt tube probe (shielded)
1 Common ground lead
1 Short ground lead for R. F. Probe
2 Alligator clips for probe tips
1 Instruction book

Accessories Available

DC High Voltage probe 50 KV 500 DC Volt range. Part No. T-79-107.
DC High Voltage probe 10 KV 100 Volt range. Part No. T-79-107.
DC High Voltage probe 5 KV 50 DC Volt range. Part No. T-79-107.
Leather carrying case. Part No 659.
Leather carrying case with sponge rubber lining. Part No. 659P.
Stand for holding tester at about a 45° angle. Part No. T-255A-33.

GENERAL DESCRIPTION

The Vacuum Tube Voltmeter is one of the most useful instruments in the electronic field, both in the laboratory and for service. Its high input impedance and wide frequency ranges give it considerable advantage over other types of volt meters. The versatility of a Triplett Model 650 is greatly increased by the skill of the operator.

Triplett Model 650 Vacuum Tube Voltmeter has been designed with all the principal features generally required in a Vacuum Tube Voltmeter plus a Single Selector Switch giving you full control of all ranges—AC-DC and OHMS with one control. This knob is flush with the panel. Also as a time saver all AC voltages up to and including RF are measured with one probe. By adding color to the various ranges the meter dial is easily read. Your Model 650 is designed with added protection for the highly sensitive meter. You will notice the selector switch has an OFF position. With the selector switch in the OFF position, the meter is out of the circuit adding greater damping to the meter and avoiding violent swinging of the pointer during transit. The OFF position on the selector switch has no relation to the 115 Volts AC power supply. AC power supply is controlled only by the slide switch located under the AC line pilot. For more convenient portability the power cord is detachable.

As Ultra High Frequency becomes more popular and you need to measure UHF voltages, your Model 650 with the Ultra High Frequency probe will read RF voltages as high as 980 MC.

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OPERATING INSTRUCTIONS

General

To place the Model 650 in operation—connect the AC line cord to the connector provided on the left side of the unit and plug into a 115 volt 60 cycle power outlet.

Turn on AC with "AC Line Switch", see page 2. The pilot will indicate when power is on.

The meter can be used after a five minute tube warm-up on the higher ranges, but to obtain maximum accuracy it is best to allow a ten minute warm-up period.

The meter is so designed that it may be left turned on continuously during your working hours without damage to the instrument. With the power consumption only 6½ watts, the cost of operation is very small.

When the VTVM is warmed-up — balance the pointer to zero by lower left thumb control marked "ZERO ADJ".

All instruments are completely adjusted and balanced at the factory so no interior adjustments should be necessary when putting a new VTVM into service. Read carefully maintenance instructions.

The following pages will illustrate each type of common measurement. Other applications will become apparent as you gain proficiency in the operation of your Model 650 Vacuum Tube Voltmeter.

AC Voltage Peak to Peak

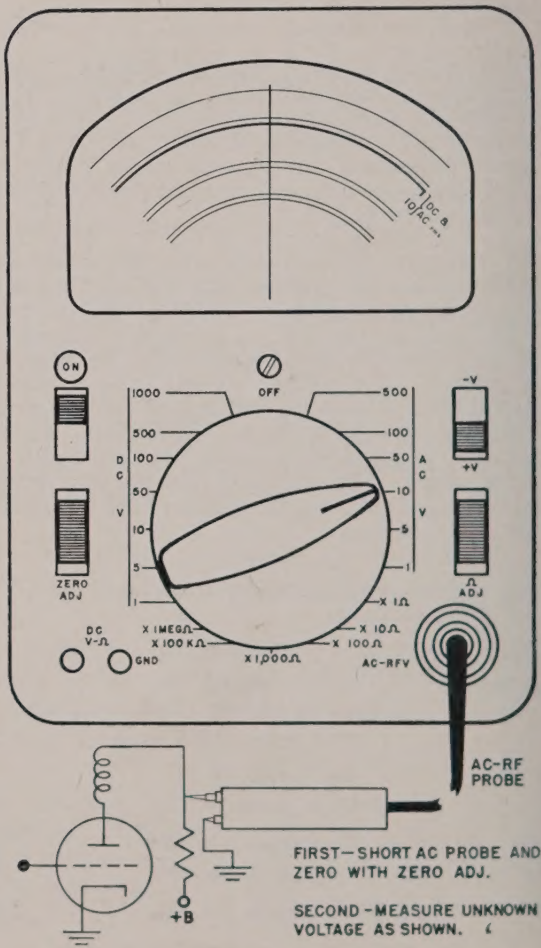
Your 650 will read peak to peak voltage. This type of voltage measurement has become very popular in TV servicing. Due to variation in wave forms found in a TV receiver a VTVM reading peak to peak voltage is necessary for good TV service. Peak to Peak Voltage can also be read on the Triplett 3440 and 3441 Oscilloscope plus the fact you can view the wave form with the same connections.

All AC voltages are measured with one probe regardless of frequency from 15 cps to 150 MC. The lead with polystyrene tip probe is used for all AC and RF measurements. Connect this lead to the 650 at connector marked AC-RFV. Select the desired AC voltage range with the selector switch and read peak to peak voltage on red scale following guide on the bottom of this page. Short probe to ground and balance pointer over "0" scale by ZERO ADJ. Remove short and make test. You will notice there are two tips on the end of the AC-RF probe. The long tip is hot for AC voltage readings. The short tip is ground for reading high frequency where short leads are necessary.

Polarity reverse switch should always be in the +V position on AC and Ohm readings.

Peak to Peak (P-P) Voltage Range	Scale to Read	Selector Switch
0–2.8	Red scale 2 8 PP	1 AC V
0–14	Red scale 14 PP	5 AC V
0–28	Red scale 28 PP	10 AC V
0–140	Red scale 140 PP	50 AC V
0–280	add 0 red scale 28 PP	100 AC V
0-700	add 00 red scale 140 PP	500 AC V

OPERATING INSTRUCTIONS
AC-RF Voltage Measurements



OPERATING INSTRUCTIONS

AC-RF Voltage (RMS)

With your 650 VTVM you now read AC or alternating current two ways, one RMS and the other Peak to Peak. Peak to Peak reading is explained under heading "AC Peak to Peak." AC power current as commonly known is RMS meaning Root Mean Square value which is the effective value of an alternating current. It corresponds to the equivalent direct current value which will produce the same heating effect. **Unless otherwise specified, alternating current values are always RMS values and will be read on RMS scales.**

All AC voltages are measured with one probe for all frequencies from 15 cps to 150 MC (If there is zero shift between the 1 AC and 500 V. AC see paragraph 2 under Maintenance.

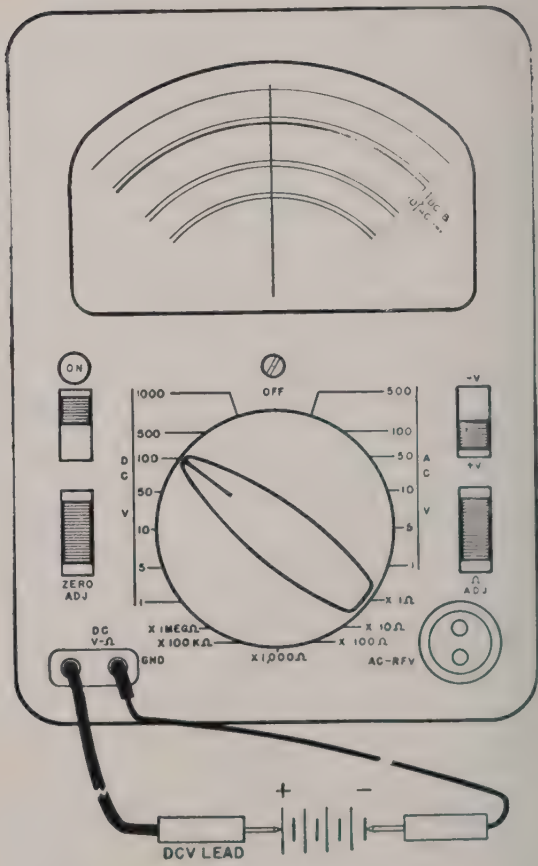
The lead with Polystyrene tip probe is used for all AC-RF measurements. Connect this lead to the instrument with the two prong connector at the point marked AC RFV. That is the only place it will fit. Select the desired AC voltage range with the Selector Switch Short probe to meter ground and balance pointer over "0" scale by ZERO ADJ. Remove short and make voltage measurement. You will notice there are two tips on the end of the AC RF probe One tip which is longer than the other, being the hot tip The shorter of the two is ground for reading very high frequency voltage. A short ground lead is supplied for reading low frequency RF voltage For AC voltages of power line frequency, the common DC ground lead or the short tip on the AC probe, can be used Both are common meter ground

Separate 1 volt AC rms and 5 volt AC rms scales assume greater accuracy.

(The meter is protected from DC voltage by a condenser in the tip of probe Superimposed AC voltage can be measured on a DC circuit because the DC is blocked by this condenser and allows only AC to pass to the meter.)

AC RMS Voltage		Scale to read
0-500	Add 0 to	0-50 Black DC—RMS
0-100	Add 0 to	0-10 Black DC—RMS
0-50		0-50 Black DC—RMS
0-10		0-10 Black DC—RMS
0-5		0-5 Black 5 RMS—ONLY
0-1		0-1 Black 1 RMS—ONLY

OPERATING INSTRUCTIONS
DC Voltage Measurements



FIRST: SHORT DC LEAD AND ZERO WITH ZERO ADJ.
SECOND: MEASURE UNKNOWN VOLTAGE AS SHOWN.

OPERATING INSTRUCTIONS

DC Voltage Measurements

All DC voltage measurements are made with a combination probe that is designed for Volts and Ohms. When reading DC Volts, turn the green sleeve counter clockwise to the stop, as illustrated below. This places a one megohm resistor in series with the probe tip.

READING DC VOLTS

Plug in the double plug end of the DCV-OHM lead making sure that the open jack side is on the ground side. Plug the common ground lead into the open jack. Now short probe and ground lead and adjust ZERO ADJ so pointer rests over Ω on meter scale. Select proper DC range. If voltage to be measured is unknown, use high range first then reset selector switch to range that will give approximately two thirds scale deflection.

The polarity reverse switch when in +V position makes your DC test probe positive and GND negative. By sliding polarity switch to -V your DC test probe becomes negative and GND positive. This switch becomes very useful when a common ground lead is connected to a chassis while taking plate voltage reading. If you want to take a grid voltage reading which is negative, slide polarity reverse switch to -V and take the reading without changing your common ground lead.

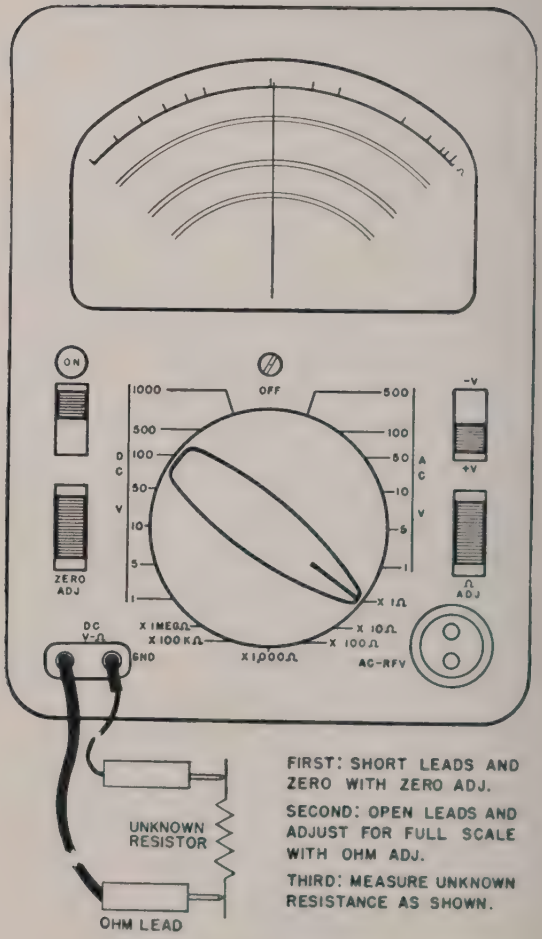
Polarity reverse switch should always be in the +V position so Ohms will read up scale.

Selecting Correct Scales

Voltage		Scale to read
0-100	Add 00 to	0-10 Black DC
0-500	Add 0 to	0-50 Black DC
0-100	Add 0 to	0-10 Black DC
0-50		0-50 Black DC
0-10		0-10 Black DC
0-5	Multiply by 2	0-10 Black DC
0-1	Divide by 10	0-10 Black DC

OPERATING INSTRUCTIONS

Resistance Measurements



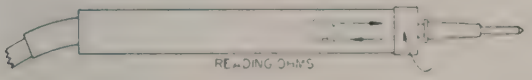
FIRST: SHORT LEADS AND ZERO WITH ZERO ADJ.

SECOND: OPEN LEADS AND ADJUST FOR FULL SCALE WITH OHM ADJ.

THIRD: MEASURE UNKNOWN RESISTANCE AS SHOWN.

Resistance Measurements DC

First: Check polarity reverse switch. It must be in the + V or down position.



Second: Set the SELECTOR SWITCH on an OHM range covering the value you estimate the unknown resistor to be. When reading ohms the green sleeve must be turned in ohms position which is obtained by turning green sleeve to the right or clockwise to stop as illustrated above. This shorts out the one megohm resistor which is necessary for reading DC Volts.

Third: Short leads and set pointer over "0" with ZERO ADJ. **(Do not touch metal part of leads.)**

Fourth: Open shorted leads and adjust for full scale reading with OHMS ADJ. Full scale being the (∞) infinity mark over 50 DC-AC rms scale. You are now ready to measure unknown resistance. Watch that your finger is not touching resistor leads or probe tips or a false reading will result.

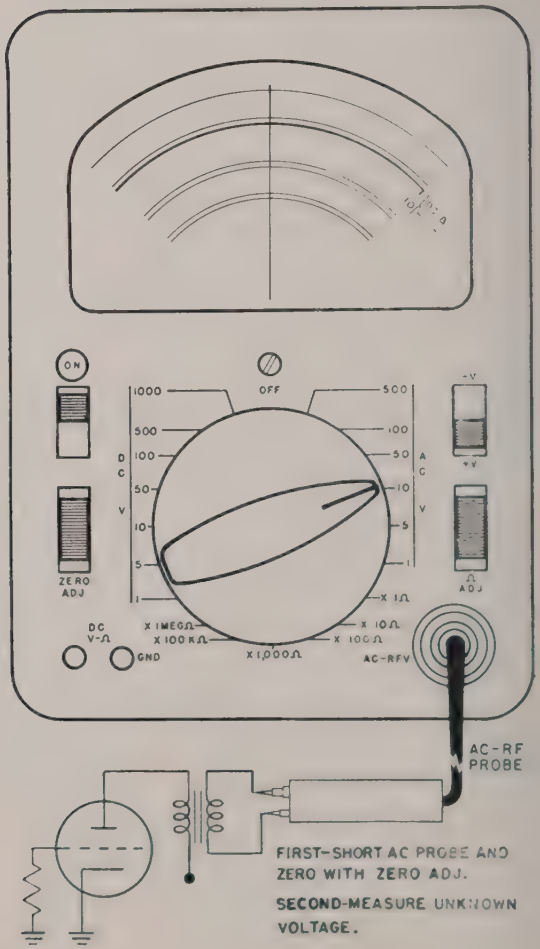
Ohm Range	Add to Reading	Selector Switch
0-1,000		X 1Ω
0-10,000	0	X 10Ω
0-100,000	00	X 100Ω
0-1,000,000	000	X 1000Ω
0-10,000,000	0000	X 10KΩ
0-1,000,000,000 (or 1,000 Meg.)	00000	X 1MEGΩ

TO MEASURE	SET SELECTOR SWITCH AT	TEST LEAD TO USE
DC Volts		**Thumb Nut in Volt Position**
0-1	1 DC V	Volt-Ohm-Lead
0-5	5 DC V	Volt-Ohm-Lead
0-10	10 DC V	Volt-Ohm-Lead
0-50	50 DC V	Volt-Ohm-Lead
0-100	100 DC V	Volt-Ohm-Lead
0-500	500 DC V	Volt-Ohm-Lead
0-1000	1000 DC V	Volt-Ohm-Lead
AC-RMS		
0-1	1 AC V	AC Probe
0-5	5 AC V	AC Probe
0-10	10 AC V	AC Probe
0-50	50 AC V	AC Probe
0-100	100 AC V	AC Probe
0-500	500 AC V	AC Probe
Ohms		**Thumb Nut in Ohm Position**
0-1000	X 1 Ohm	Volt-Ohm-Lead
0-10,000	X 10 Ohms	Volt-Ohm-Lead
0-100,000	X 100 Oms	Volt-Ohm-Lead
0-1,000,000	X 1000 Ohms	Volt-Ohm-Lead
0-100 Meg.	X 100K Ohms	Volt-Ohm-Lead
0-1000 Meg.	X 1 Megohm	Volt-Ohm-Lead
Decibels		
See Chart	1 AC V	AC-RF Probe
	5 AC V	AC-RF Probe
-26 to +40	10 AC V	AC-RF Probe
	50 AC V	AC-RF Probe
See pages 16 17	100 AC V	AC-RF Probe
Peak To Peak		
0 - 28	1 AC V	AC-RF Probe
0 - 14	5 AC V	AC-RF Probe
0 - 28	10 AC V	AC-RF Probe
0 - 140	50 AC V	AC-RF Probe
0 - 280	100 AC V	AC-RF Probe
0 - 700	500 AC V	AC-RF Probe

CHART

AD ON SCALE	SCALE	REMARKS
lack Scales		
0-10 DC	10	Be sure the green sleeve is in the DC position on test probe. DC Volts, see pages 10-11.
0-50 DC	10	
0-10 DC	Read direct	
0-50 DC	Read direct	
0-10 DC	X 10	
0-50 DC	X 10	
0-10 DC	X 100	
lack Scales		
DC-RMS	Read direct	See instructions for AC-RMS reading on pages 8-9.
DC-RMS	Read direct	
0 DC-RMS	Read direct	
0 DC-RMS	Read direct	
0 DC-RMS	X 10	
0 DC-RMS	X 10	
Scale "Ohm"		
000 Ohms	Read direct	Be sure the green sleeve is in the Ohm position. See instructions for resistance measurements on pages 12-13.
000 Ohms	X 10	
000 Ohms	X 100	
000 Ohms	X 1000	
000 Ohms	X–100,000	
000 Ohms	X 1 Megohm	
lack AC Scales		See instructions for Decibel measurements on pages 16-17.
Red Scales		
2.8 P. P.	Read direct	See instructions for Peak to Peak voltage reading on page 7.
14 P. P.	Read direct	
28 P. P.	Read direct	
140 P. P.	Read direct	
28 P. P.	X 10	
140 P. P.	X 10	

OPERATING INSTRUCTIONS
A. F. or Decibels



FIRST-SHORT AC PROBE AND ZERO WITH ZERO ADJ.

SECOND-MEASURE UNKNOWN VOLTAGE.

A. F. or Decibels

Audio output generally is measured in units called the Decibel, a terminology used to indicate audio power levels in a.f. amplifier or telephone work. Zero DB is set at 1.73 Volts, this being the voltage developed across a 500 Ohm line when .006 Watts is dissipated in the line.

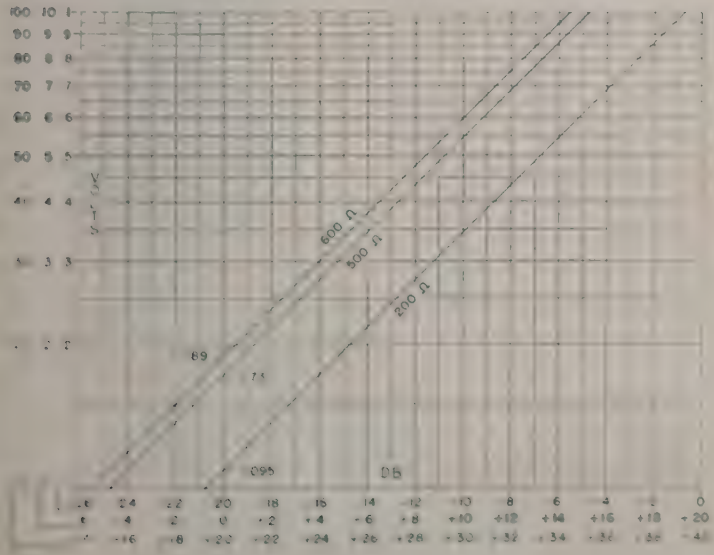
DO NOT confuse the DB with the VU (Volume Unit). The VU is based on .001 Watt dissipated in a 600 ohm line and is measured with a meter having special ballistic characteristics.

Decibels are measured by means of the gray lead with Polystyrene tip which was used to measure AC voltage.

Set SELECTOR SWITCH for correct range of level to be measured. Balance pointer to "0" with ZERO ADJ.

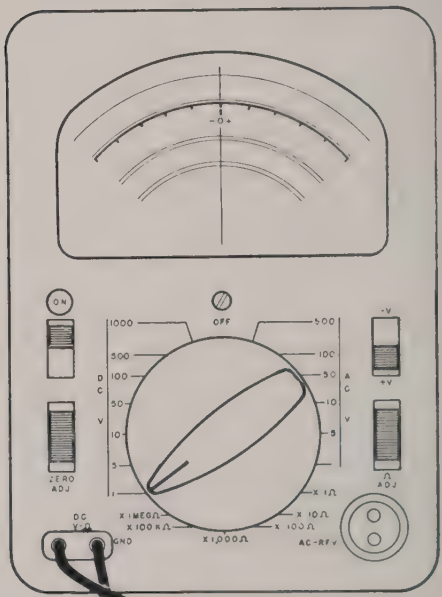
6MW Reference Level

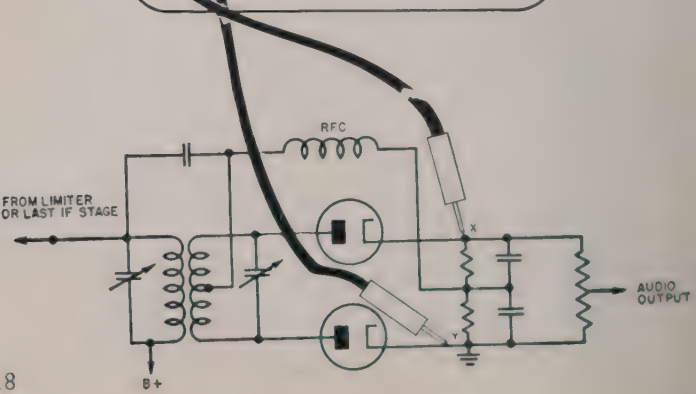
Read all DB on the Black AC scale using this chart.



OPERATING INSTRUCTIONS

Galvanometer Zero Center Scale





Galvanometer Zero Center Scale

Zero center scale is available for lining up the discriminator in FM circuit.

When it is desired to use the Zero center scale as a galvanometer set the SELECTOR SWITCH at 1 Volt DC range. Adjust pointer to center zero or to Red –0+ in the center of 0-10 DC scale with the ZERO ADJ. The meter will now read –.5, 0, +.5 Volts.

Higher ranges are available. Note the table below.

Read on Center Zero	Selector Switch Range
– .5 0 + .5	1 V. DC
2.5 0 + 2.5	5 V. DC
– 5 0 + 5	10 V. DC
25 0 + 25	50 V. DC
50 0 + 50	100 V. DC
–250 0 + 250	500 V. DC
–500 0 + 500	1000 V. DC

Illustration on opposite page suggests use of center zero scale in realignment of FM discriminator circuit.

Pointer "0" Adjustment

Set SELECTOR SWITCH on OFF position, adjust pointer to "0" with zero adjustment screw just above the word OFF on the selector switch.

Pointer Shift DC to AC Ranges

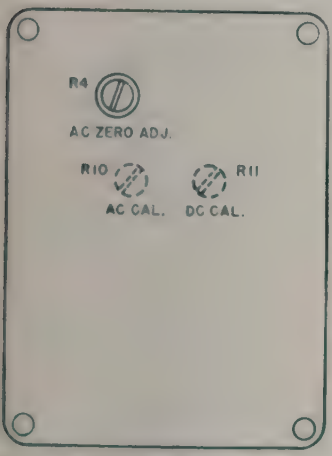
Insert both AC-RF and DCV probes and short all tips to ground. Allow instrument to warm up for 10 minutes. Set SELECTOR SWITCH to 1 V DC range, balance pointer to "0" with Zero Adj.. Now set SELECTOR SWITCH to 1 V AC. (Do not reset the ZERO ADJ.) With a small screwdriver adjust the potentiometer through the hole in the back of the tester so that the pointer is over "0" on all ACV and DCV ranges when switching from 1 DCV to 1 ACV through DCV and ACV ranges. In general this adjustment is not necessary and should be used only if the line voltage varies more than 10%.

When replacing AC probe the above adjustment should be made.

Recalibrating DC Voltage Ranges

The DC ranges can be adjusted by a potentiometer adjustment marked DC CAL. inside the case. The seal on this adjustment should not be broken unless you have some means of accurate standard known voltage for recalibration. To recalibrate, set SELECTOR SWITCH at 50 Volt DC range and apply accurately 50 Volts DC to the DC test probes. Adjust potentiometer marked DC CAL. so the meter reading is 50 Volts full scale. Then reseal potentiometer with glyptol.

Recalibrating AC Voltage Ranges



BACK OF INSTRUMENT

The AC ranges can be recalibrated by a potentiometer adjustment marked AC CAL. inside the case. The seal on this adjustment should not be broken unless you have some means of accurate standard known voltage for recalibration. To recalibrate, set SELECTOR SWITCH at 5 Volt AC range and apply accurately 5 Volts AC to the AC test probe· adjust potentiometer marked AC CAL. so the meter reading is 5 Volts full scale. Then reseal potentiometer with glyptol.

In case of damage to AC-RF probe send to factory for repair. Replacements are also available.

Battery Replacement

The 1 5 Volt "C" cell is used for resistance measurements only If you are unable to adjust pointer to full scale as explained on page 13 replace the battery or ohms do not read correctly replace the 1 5 volt cell

Tube Replacement

Should it become necessary to replace a tube, the following procedure should be followed. The three tubes in your Model 650 VTVM have been aged and selected. It will also be necessary for you to select a suitable tube as only 75% of the tubes supplied for general use are suitable for accurate measuring instruments. The 12AU7 tube must be aged 100 hours. This can be done in your Model 650 unit.

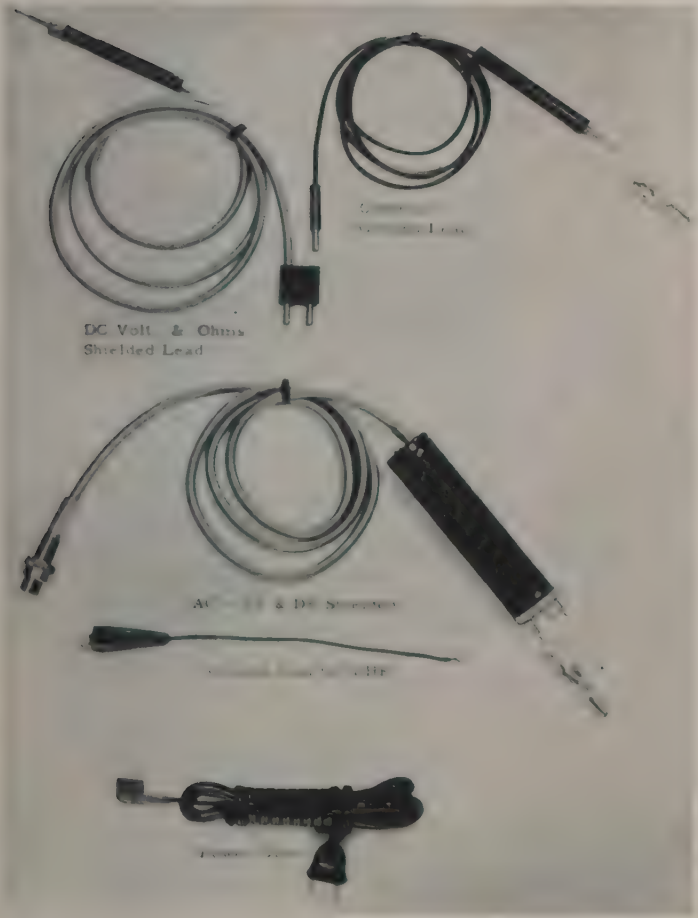
1—Select a 12AU7 Tube that after a 15 minute warm up period is fairly stable when changing SELECTOR SWITCH from 1 Volt DC to 1000 Volt DC stopping on each DC range. If the pointer changes more than ¾ of one division on the 10 Volt DC scale, the tube is not suitable to age.

Now that the replacement tube has been selected, age it in your Model 650 with the AC line switch ON for 100 hours. Sometimes it is possible that a tube will prove unstable after being aged. In such case the procedure must be repeated.

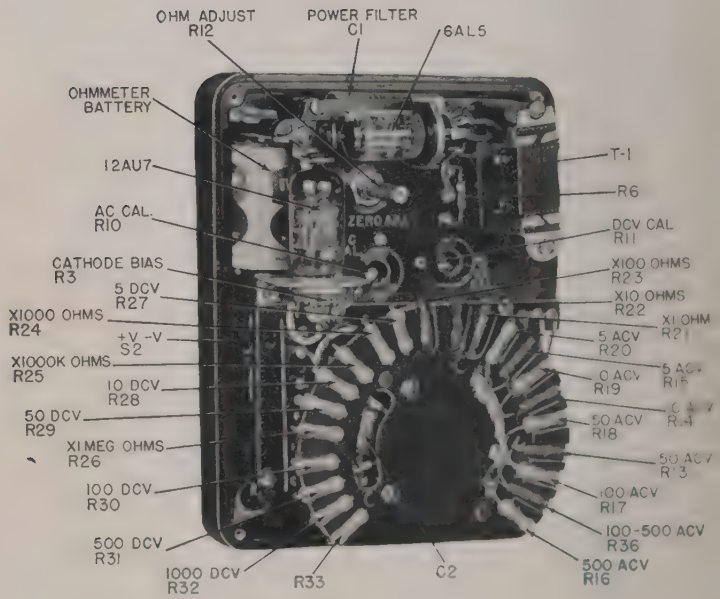
The 6AL5 tube inside the tester needs no aging or adjustments made if replaced.

We recommend that all major recalibrating and repairs be done by the manufacturer. Our meter maintenance department is at your service. When necessary to return your instrument for repair, please write for return authorization

CABLES SUPPLIED WITH MODEL 650



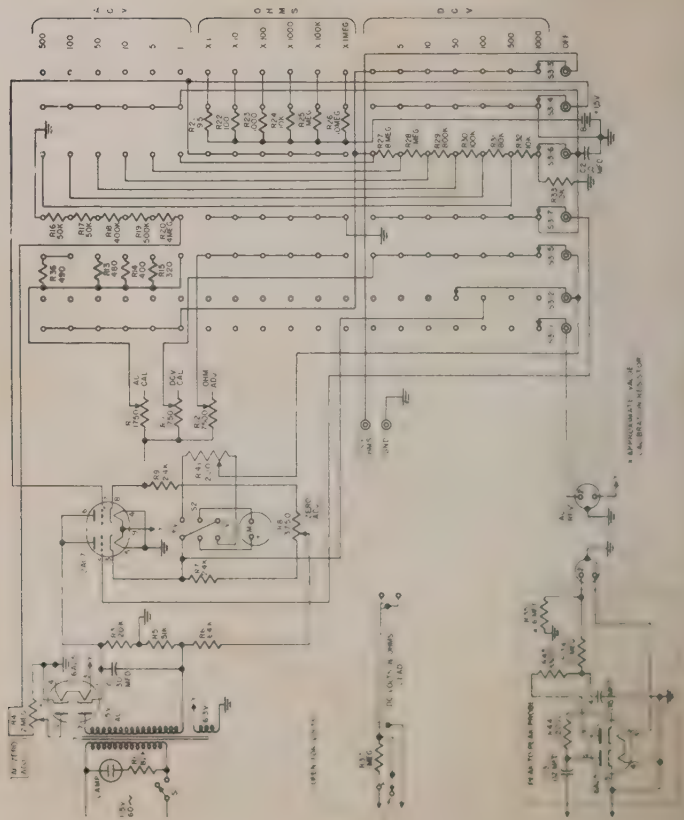
Model 650 Parts Location



PARTS LIST

REF. NO.	QUAN.	PART NAME	DESCRIPTION	TRIPLETT PART NO.
			Fixed, 30 MFD 150V DC, ±10%	T-43-103
	1			T-43-101
	1		Fixed 82K ohms, ½W, ±20%	T-15-1745
	1		Fixed, 25K ohms, ½W, ±5%	T-15-1686
	1		Variable, 2 meg., ±20%	T-16-79
	1		K ohms, W,	T-15-1079
R9	2		K ohms, W, ±10%	T-15-1757
	2		4K ohms, W, ±1%	T-15-1738
	2		Variable, 7500 ohms, 1/10W, ±10%	T-16-60
	2		Variable, 1750 ohms, ±5%	T-16-62
	1		Fixed, 480 ohms, Wirewound	T-15-2126
	1		Fixed, 400 ohms, ±1%, Wirewound	T-15-2125
	1		Fixed, 320 ohms, ±1%, Wirewound	T-15-2124
	2		ohms, W, ±1%	T-15-1274
	1		W,	T-15-1167
	1		W,	T-15-1203
	1		W,	T-15-1238
	1		Fixed, 9.5 ohms, ±1%, Wirewound	T-15-1733
	1		Fixed, 100 ohms, ±1%, Wirewound	T-15-1734
	1		Fixed, 1000 ohms, Wirewound	T-15-1735
R24				
R32				
R33				
	1		Fixed, 10K ohms ½W, ±1%	T-15-1014
	1		Fixed, 1 meg ohm, ½W, ±1%	T-15-1358
	1			
	1		W,	T-15-1129
	1		Fixed, 800K ohms, ½W, ±1%	T-15-1137
	1		Fixed 100K ohms, ½W, ±1%	T-15-1727
	1		Fixed, 80K ohms, ½W, ±1%	T-15-1728
	1		Fixed 490 ohms ±1% Wirewound	T-15-2127
	1		Fixed, 7500 ohms, ½W, ±10%	T-15-1212
	1		250 ua, approximately 400 ohms	T-52-619
	1		115V AC	T-23A-61
	1		5V size "C"	T-2426-2
	1		20 position, 7 deck	T-22B-150
	1		Neon 1 25 W	T-3024-2
	1		Slide SPST	T-22A-154
	1		Slide DPDT	T-22-152
	1		prong midget	T-2455-91
	1		7 hole miniature	T-2455-59
	1		aged	T-2600-12AU7
	1		6AL5, aged	T-2600-6AL5
	1		15/32L, molded	T-34-30
	1		Knob retaining	T-2451-5
	1		Bakelite with strap handle	T-10-953
	2		Jack contacts	8944
			TEST LEADS	
	1		Power Cord	T-2566-47
	1		Common Ground Lead	T-79-108
	1		DC Volt and Ohm Shielded Lead	T-79A-1
	1			
	1		Ground Lead	T-79A-111
			(used with RF shielded probe)	

Model 650 Schematic Diagram



WARRANTY FOR RADIO AND TELEVISION INSTRUMENTS AND TEST EQUIPMENT

(Including Maintaining Parts of Discontinued Models)

Adopted and Recommended by the Radio-Electronic-Television Manufacturers Association, 1951

The Triplett Electrical Instrument Company warrants instruments manufactured by it to be free from defective material or factory workmanship and agrees to repair such instruments which under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any instrument or test equipment which proves to be defective, when returned to us, transportation prepaid, within ninety (90) days fom the date of original purchase and provided the serial number has been made known to us promptly for our records.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons or service stations in any way so as, in our judgment, to injure their stability or reliability or which have been subject to misuse, negligence, or accident, or which have had the serial number altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, or adjusted otherwise than in accordance with the instructions furnished by us. Accessories including all vacuum tubes not of our manufacture used with this product are not covered by this warranty.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

Parts will be made available for a minimum period of five (5) years after the manufacture of this equipment has been discontinued. Parts include all materials, charts, instructions, diagrams, accessories, et cetera, which have been furnished in the standard model.

RED-DOT LIFETIME GUARANTEE

The Red-Dot Lifetime Guarantee made only by Triplett warrants the meter to be free from defects in material and workmanship for the life of its original user.

The Triplett Electrical Instrument Company
Bluffton, Ohio

THE TRIPLETT ELECTRICAL INSTRUMENT CO.

Bluffton - - Ohio, U. S. A.

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